



DARK ENERGY  
SURVEY

# DES Standard Stars Discussion

(see also DES-doc#7180)

Douglas L. Tucker

DES Collaboration Meeting

11 April 2013 (1:15PM)



# Fields to Calibrate

DARK ENERGY  
SURVEY

- MaxVis Calibration field
  - Completely uncalibrated
  - Calibrate using nightly standard star solutions (PSM) and multiple observations of MaxVis field
- E2\_a, E3\_a, E4\_a, E6\_a fields
  - Southern u'g'r'i'z' mags for central 10 arcmin x 10 arcmin of the DECam focal plane
  - Need to extend calibration to stars on rest of focal plane
  - Could possibly calibrate using the local standards; otherwise use nightly standard star solutions (PSM) and multiple observations of these fields.
- C26202
  - HST standard (1 star), plus CDFS info from Southern u'g'r'i'z' project.
- BD+17 4708
  - DECam fundamental flux standard
  - Very bright – wait until DECam non-linearities better understood <sup>2</sup>



DARK ENERGY  
SURVEY

# Install Stuff

1. Check out Photometric Standards Module (PSM) results from FinalCut Processing:

<https://cosmology.illinois.edu/confluence/display/Operations/Y1-C1+FinalCut+Production+Runs>

2. Download the Southern u'g'r'i'z' standards:

<http://www-star.fnal.gov/>

3. Download the TOPCAT VO tool:

<http://www.star.bris.ac.uk/~mbt/topcat/>

4. If you have not already done so, apply for access to the DESDM database:

<http://desdm.wufoo.com/forms/desdm-data-access-form/>

5. Download the trivialAccess DESDM database client:

<https://cosmology.illinois.edu/confluence/display/PUB/Downloading+and+Installing+the+DESDM+Client>



# trivialAccess Practice

DARK ENERGY  
SURVEY

---

---

## 3. Start up trivial access

(be sure to replace UUUUUU and PPPPPP with your DESDM database username and password):

```
trivialAccess -u UUUUUU -p PPPPPP  
psql> ?
```

## 4. Look at the descriptions of the relevant tables:

```
psql> describe_table EXPOSURE
```

(contains info for each exposure -- i.e., for the full focal plane for that observation)

```
psql> describe_table IMAGE
```

(contains info for each CCD image within an exposure)

```
psql> describe_table OBJECTS
```

(contains info for each detected object within a CCD image)  
[this particular command might not work]

```
psql> describe_table PSMFIT
```

(contains info for the standard star solution for the night)



# Grab Observations of MaxVis Calibration Field from FinalCut Catalog

DARK ENERGY  
SURVEY

```
SELECT e.id as exposureid, o.imageid, o.object_id, o.x_image, o.y_image,
       o.ra, o.dec, o.mag_psf, o.magerr_psf, o.zeropoint, o.zeropointid,
       3600.*o.fwhm_world as fwhm_arcsec, o.spread_model, o.flags,
       e.nite, i.run, e.propid, e.object, e.band, i.ccd, e.airmass,
       e.mjd_obs, e.exptime, e.photflag, i.skybrite, i.skysigma, i.elliptic
       as image_ellipt, 0.27*i.fwhm as image_fwhm_arcsec, i.saturate as
       image_sat_level, i.imagetype, p.*  
  
FROM exposure e join image i on i.exposureid=e.id
      join objects_current o on o.imageid=i.id
      left join psmfit p ON (p.run=i.run AND p.filter=i.band and
      p.ccdid=i.ccd)  
  
WHERE (o.ra between 95.5 and 99.5) AND (o.dec between -60.75 and -56.75)
      AND (e.object like '%MaxVis%') # MaxVis Field
      AND (e.camshut='Open') and (e.telstat='Track') # Good exposure
      AND o.flags=0 # Good measurement
      AND (i.run like '201302%' or i.run like '201303%') #Y1-C1 FinalCut
      AND (o.spread_model between -0.002 and 0.002) #Star
      AND (o.mag_psf > 0.0 and o.mag_psf < 15.0) # Good PSM instr mags
      AND e.nite='20130115' # The night (can be removed when ready)
```

(Thanks to Brian Yanny and Robert Gruendl for help with this query!)  
(Any errors are mine.)



DARK ENERGY  
SURVEY

## Split Resulting CSV file by Filter

```
awk -F, 'BEGIN{OFS=","} NR==1 || $19=="u"' MaxVis.csv > MaxVis_u.csv
awk -F, 'BEGIN{OFS=","} NR==1 || $19=="g"' MaxVis.csv > MaxVis_g.csv
awk -F, 'BEGIN{OFS=","} NR==1 || $19=="r"' MaxVis.csv > MaxVis_r.csv
awk -F, 'BEGIN{OFS=","} NR==1 || $19=="i"' MaxVis.csv > MaxVis_i.csv
awk -F, 'BEGIN{OFS=","} NR==1 || $19=="z"' MaxVis.csv > MaxVis_z.csv
awk -F, 'BEGIN{OFS=","} NR==1 || $19=="Y"' MaxVis.csv > MaxVis_Y.csv
```



DARK ENERGY  
SURVEY

# Look at and do initial calibration of data (Using TOPCAT as example)

The screenshot shows the TOPCAT software interface. The title bar reads "TOPCAT". The toolbar contains various icons for file operations, selection, and analysis. The main window is divided into several panels:

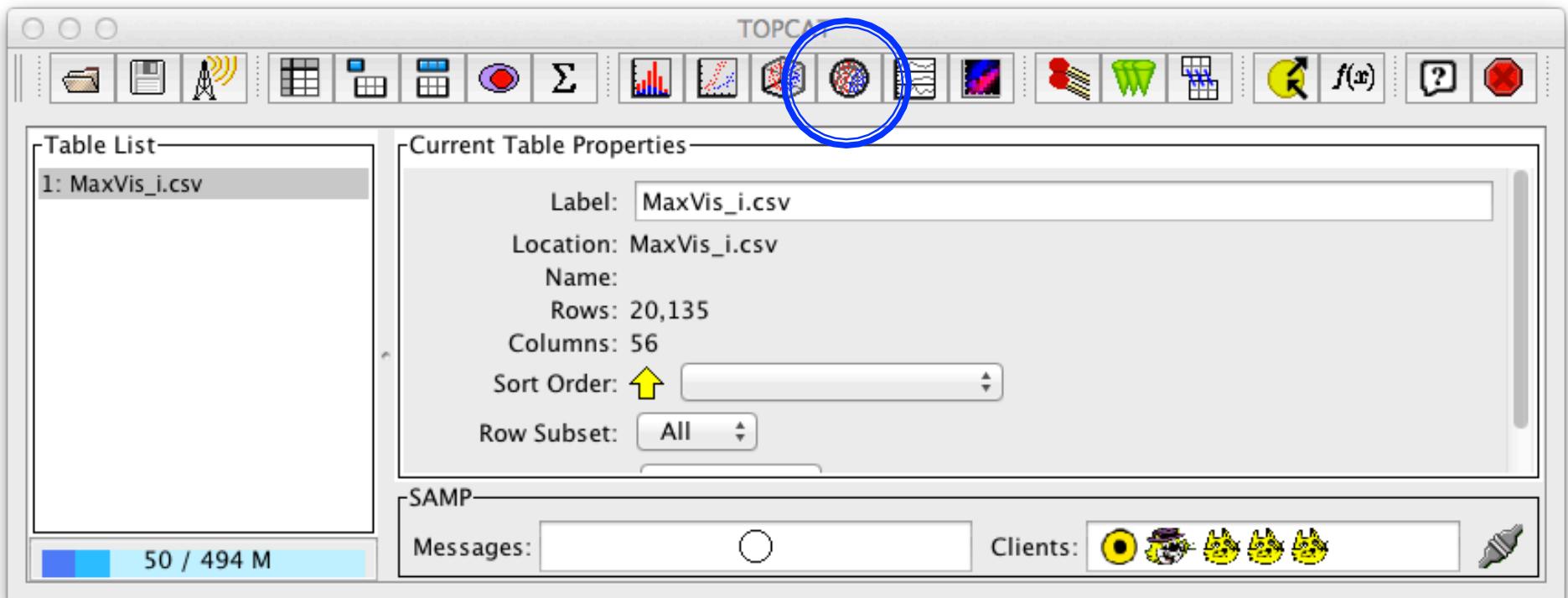
- Table List:** Shows a single entry: "1: MaxVis\_i.csv".
- Current Table Properties:** Displays information about the current table:
  - Label: MaxVis\_i.csv
  - Location: MaxVis\_i.csv
  - Name:
  - Rows: 20,135
  - Columns: 56
  - Sort Order: Upward arrow icon
  - Row Subset: All
- SAMP:** Displays message and client status.

At the bottom, there is a progress bar showing "50 / 494 M".



DARK ENERGY  
SURVEY

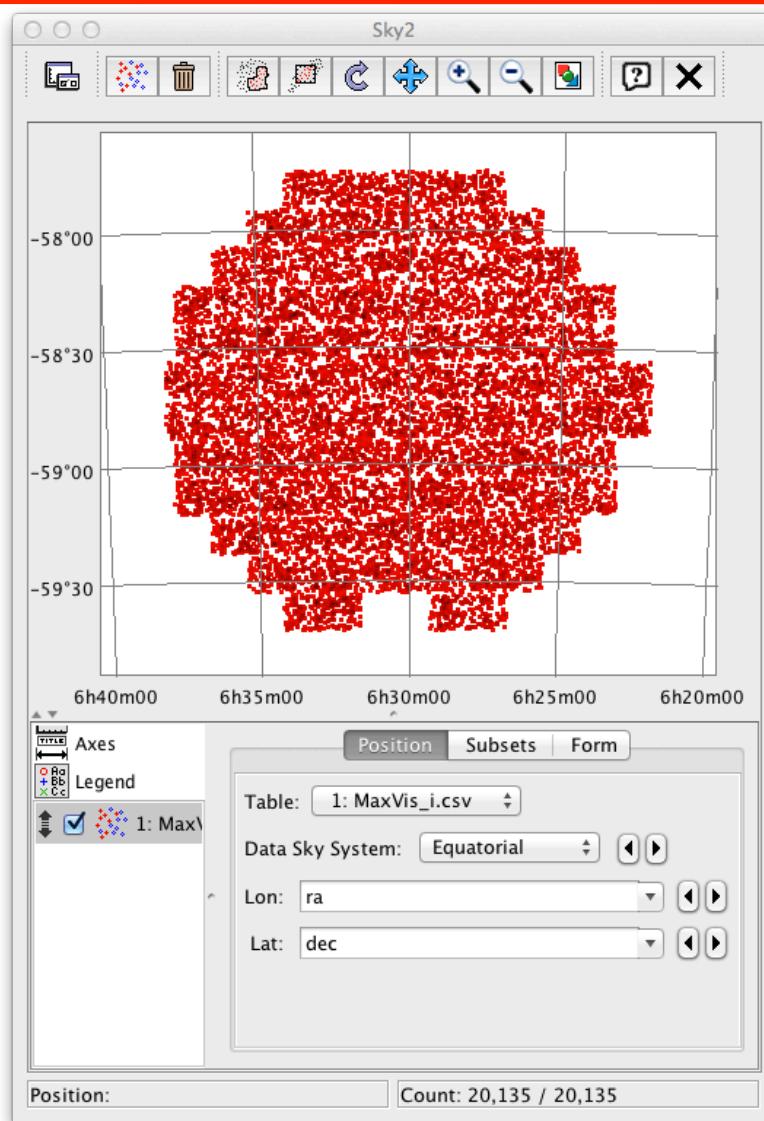
# Look at and do initial calibration of data (Using TOPCAT as example)





# Plot of MaxVis Results in RA, DEC (TOPCAT Graphics Sky Layer Plot Example)

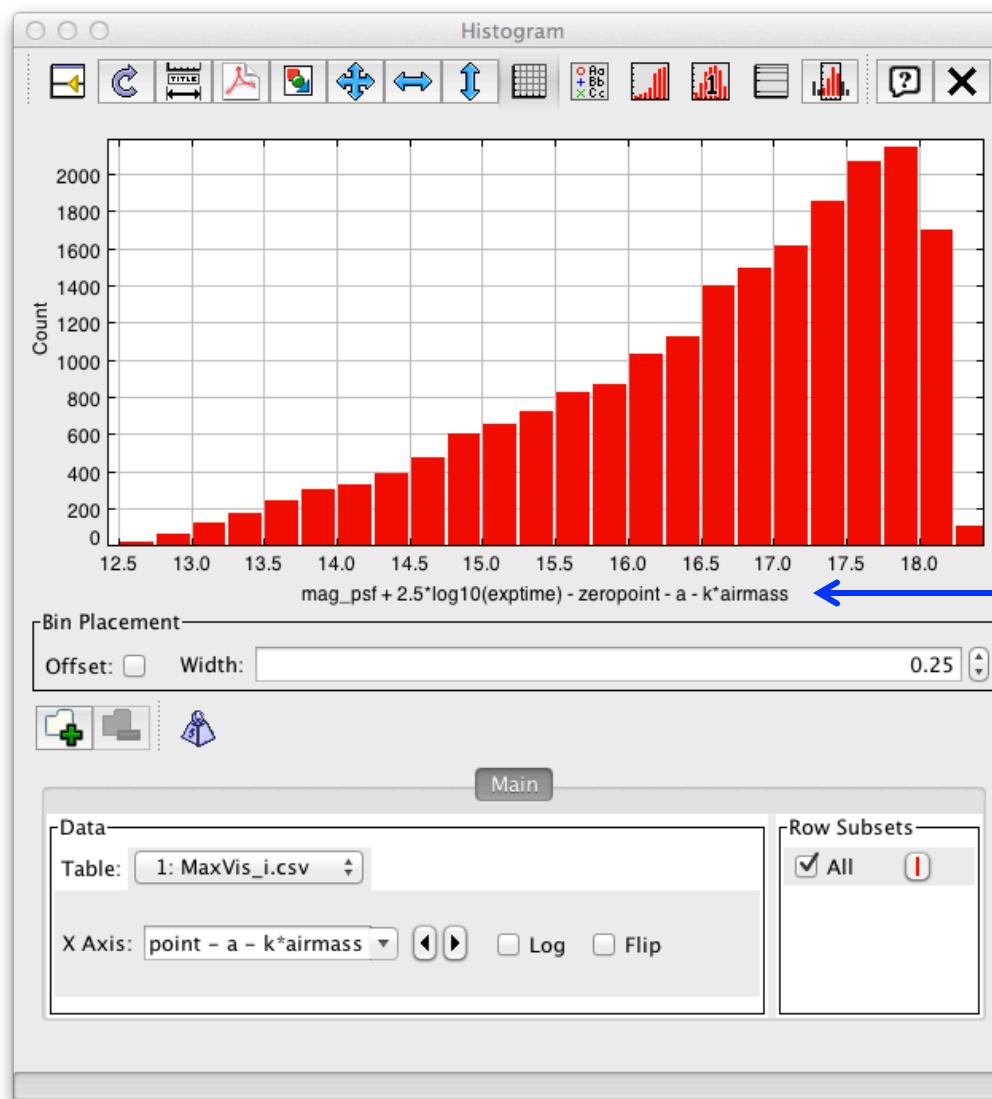
DARK ENERGY  
SURVEY





DARK ENERGY  
SURVEY

# Initial Calibration without Color Terms (TOPCAT Histogram Example)



Here's the  
equation



DARK ENERGY  
SURVEY

## Issues

- SDSS vs. DES natural system
  - PSM results are currently for the DES system
  - Offsets in system zeropoint offsets (one per filter)
  - Definition of DES natural system
- CCD-to-CCD color terms
  - Even in DES natural system, but close to 0.
- Saturation at bright mags?
- QA checks



DARK ENERGY  
SURVEY

# Extra Slides



# To Calibrate a Star to the SDSS/UKIDSS System (g-band example)

DARK ENERGY  
SURVEY

```
g = g_instr - a_g - b_g*( (g-r) - (g-r)0 ) - k_g * X
```

where `g_instr` is the instrumental magnitude (see below)

`a_g` is the photometric zeropoint ("a" from the PSMFIT table)

`b_g` is the instrumental color term coefficient  
("b" from the PSMFIT table)

`(g-r)` is the calibrated g-r color of the star

`(g-r)0` is a reference color ("stdColor0" from the PSMFIT table)

`k_g` is the first-order extinction ("k" from the PSMFIT table)

`X` is the airmass ("airmass" from the EXPOSURE table)

and where

```
g_instr = mag_aper_8 + 2.5*log10(exptime) - zeropoint
```

where `mag_aper_8` is the sextractor mag

("mag\_aper\_8" from the OBJECTS table)

`exptime` is the exposure time in seconds

("exptime" from the EXPOSURE table)

`zeropoint` is the instrumental mag zeropoint

(zeropoint from the OBJECTS table; generally = 25.0)



# DES Photometric Equations

DARK ENERGY  
SURVEY

---

---

```
u = u_instr - a_u - b_u*( (u-g) - (u-g)0 ) - k_u * X
g = g_instr - a_g - b_g*( (g-r) - (g-r)0 ) - k_g * X
r = r_instr - a_r - b_r*( (g-r) - (g-r)0 ) - k_r * X
i = i_instr - a_i - b_i*( (i-z) - (i-z)0 ) - k_i * X
z = z_instr - a_z - b_z*( (i-z) - (i-z)0 ) - k_z * X
Y = Y_instr - a_Y - b_Y*( (z-Y) - (z-Y)0 ) - k_Y * X
```

Currently:

$$(u-g)0 = 1.39$$

$$(g-r)0 = 0.53$$

$$(i-z)0 = 0.09$$

$$(z-Y)0 = 0.05$$



# Match DES Observations with Betoule et al. SDSS Stripe 82 Catalog (TOPCAT)

DARK ENERGY  
SURVEY

(from DES-doc#7180)

The screenshot shows the TOPCAT software interface. At the top, there is a toolbar with various icons. A blue circle highlights the icon at position 18 from the left, which is a red and yellow icon representing a join or merge operation. Below the toolbar, the window is divided into several panels:

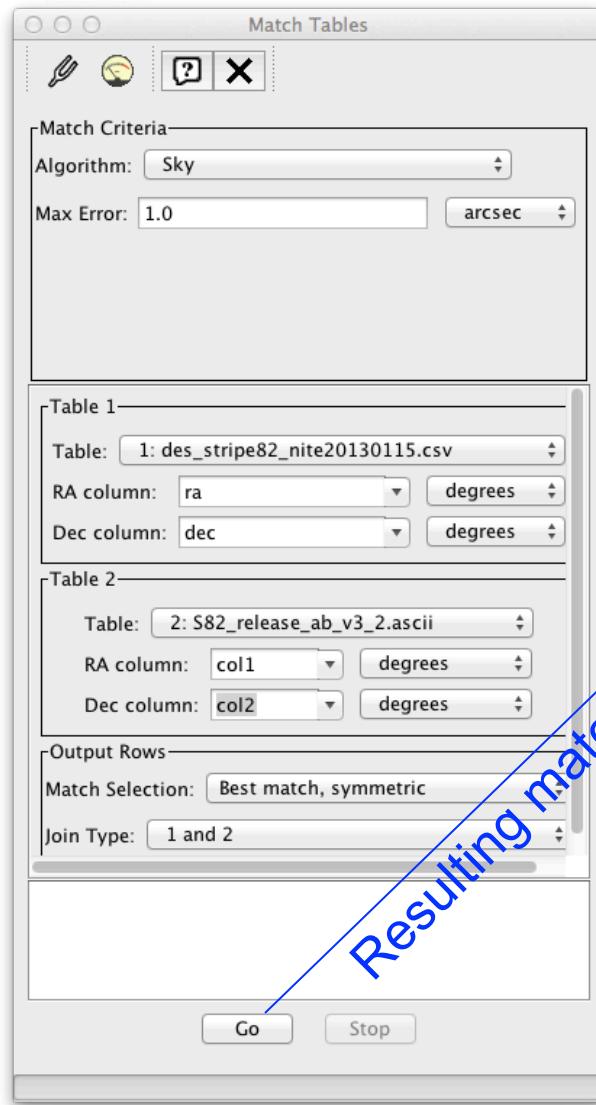
- Table List:** Shows two entries: 1: des\_stripe82\_nite20130115.csv and 2: S82\_release\_ab\_v3\_2.ascii.
- Current Table Properties:** Displays information about the selected table:
  - Label: des\_stripe82\_nite20130115.csv
  - Location: des\_stripe82\_nite20130115.csv
  - Name:
  - Rows: 24,311
  - Columns: 30
  - Sort Order: An arrow points to a dropdown menu.
  - Row Subset: All
- SAMP:** Shows message and client status indicators.

At the bottom, a progress bar indicates "106 / 494 M".



# Match DES Observations with Betoule et al. SDSS Stripe 82 Catalog (TOPCAT)

DARK ENERGY  
SURVEY



(from DES-doc#7180)

